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(54) **ROOF VENTILATION SYSTEM FOR TILED ROOF**

(76) Inventor: **William Boone DANIELS**, Languenan (FR)

Correspondence Address:
KNOBBE MARTENS OLSON & BEAR LLP
2040 MAIN STREET, FOURTEENTH FLOOR
IRVINE, CA 92614

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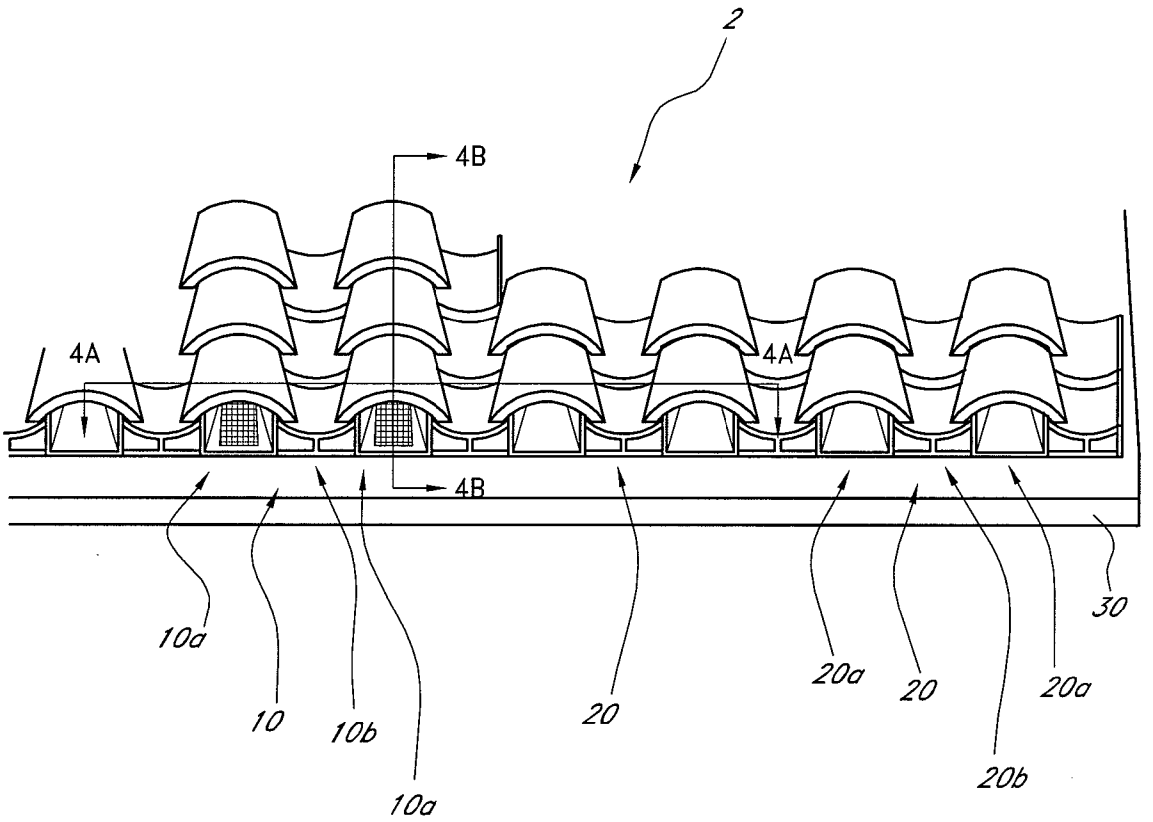
E04D 1/30 (2006.01)

(52) **U.S. Cl.** **52/199**; 52/748.1

(57) **ABSTRACT**

A roof ventilation for a roof having roof tiles with air channels is disclosed. The roof includes a roof supporting structure, a plurality of roof tiles, and at least one vent tile. The plurality of roof tiles reside over the roof supporting structure. The roof tiles include air channels formed therethrough which are in ventilating communication with one another. The least one vent tile resides over the roof supporting structure. Each of the at least one vent tile includes a first upper plate, a second upper plate, and a lower plate. The first and second upper plates are spaced apart from each other, forming a ventilating access. The second upper plate has a first opening and the lower plate has a second opening. The first opening is in ventilating communication with the second opening and with at least one of the air channels. The ventilating access and the first and second openings together permit airflow between regions above and below the roof. The at least one of the air channels is substantially aligned with a space between the upper and lower plates.



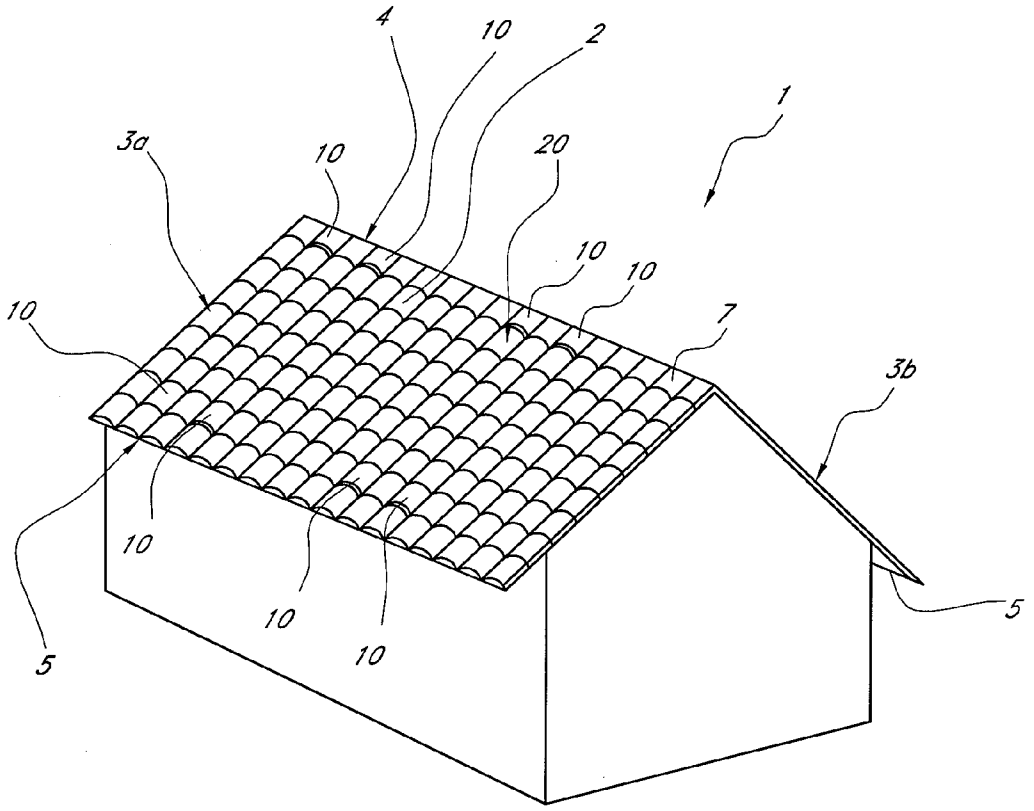


FIG. 1

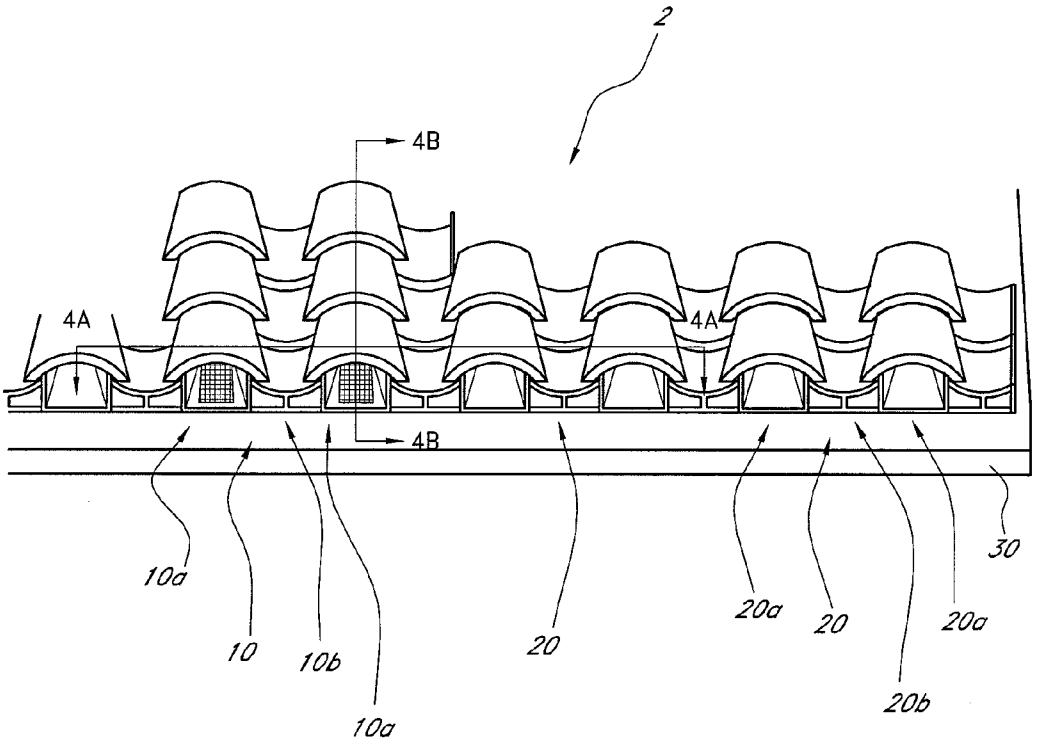


FIG. 2

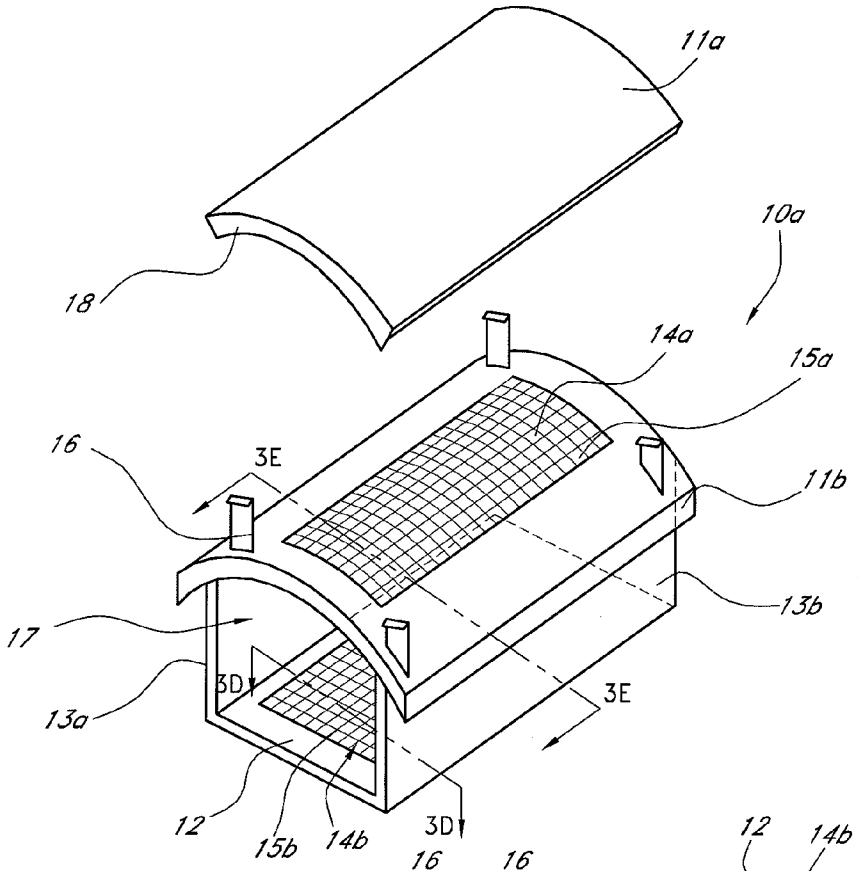


FIG. 3A

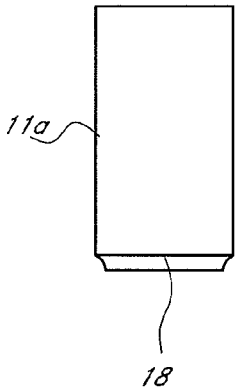


FIG. 3B

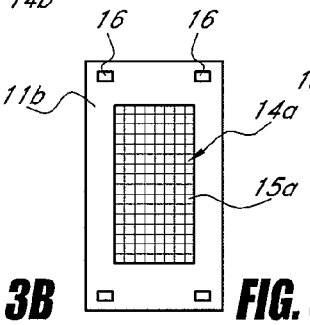


FIG. 3C

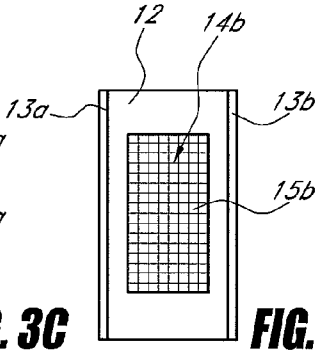


FIG. 3D

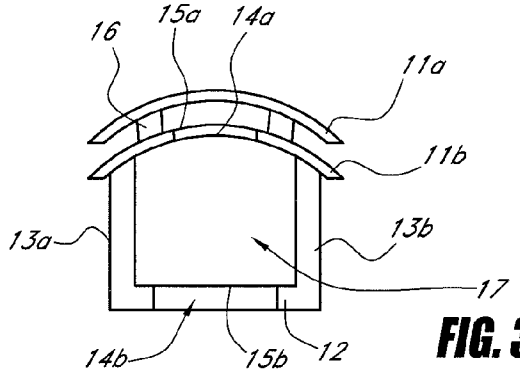


FIG. 3E

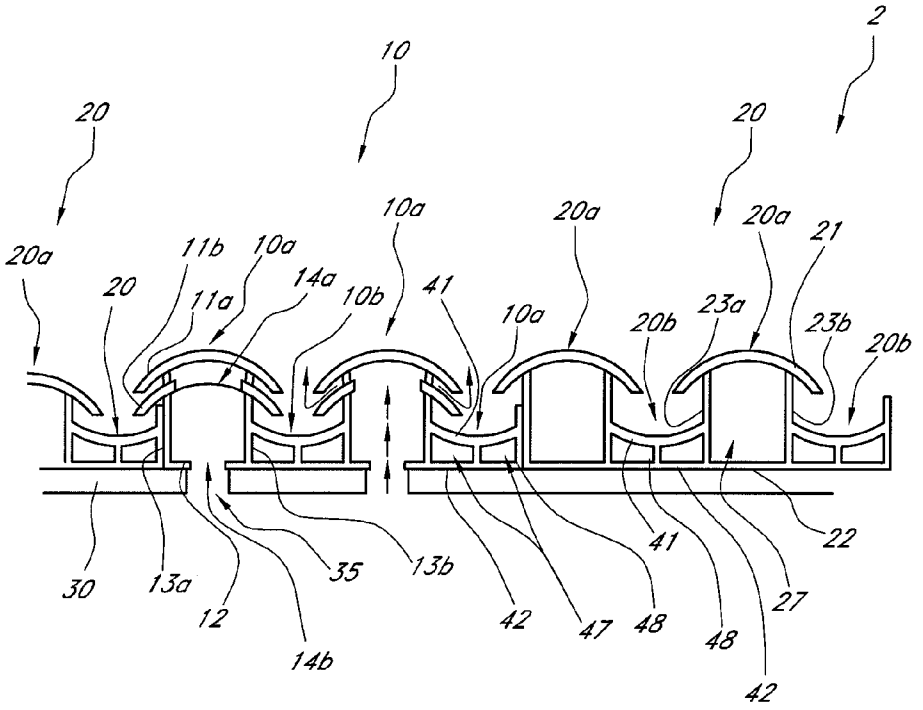

2
10
20
20
20a
20a
11b
10a
10a
20a
20a
21
20
11a
14a
10b
41
10a
20b
23a
23b
20b
30
13a
12
35
13b
42
47
48
41
48
27
22
14b
42

FIG. 4A

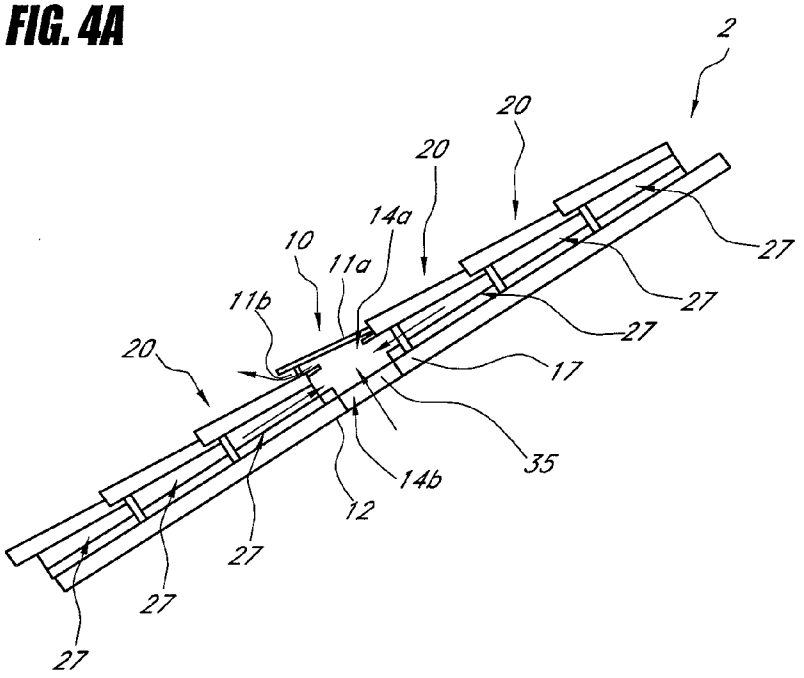

2
20
20
14a
10
11a
11b
27
27
27
20
17
35
14b
12
27
27
27

FIG. 4B

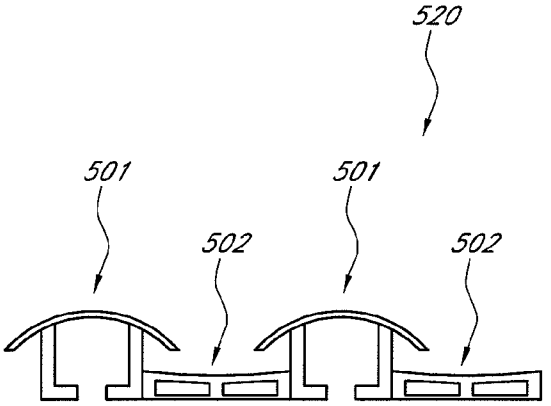


FIG. 5A

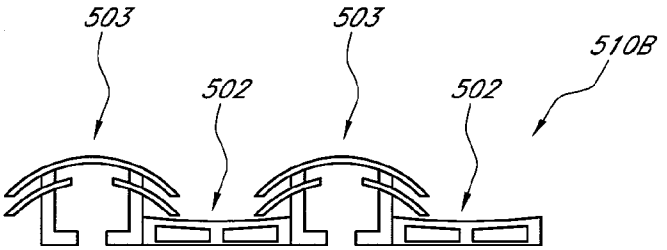


FIG. 5B

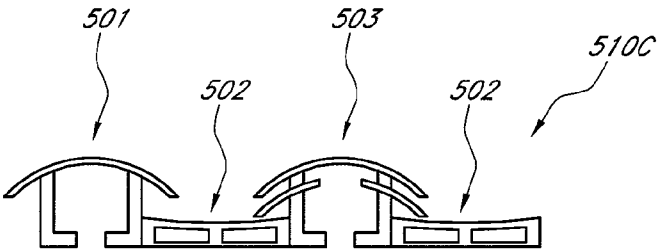


FIG. 5C

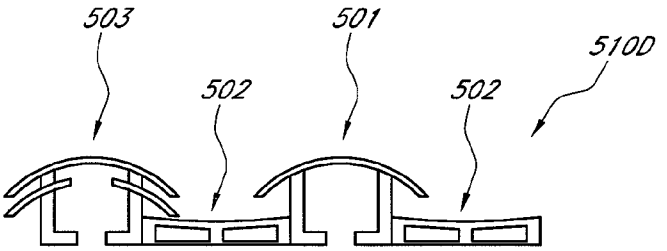


FIG. 5D

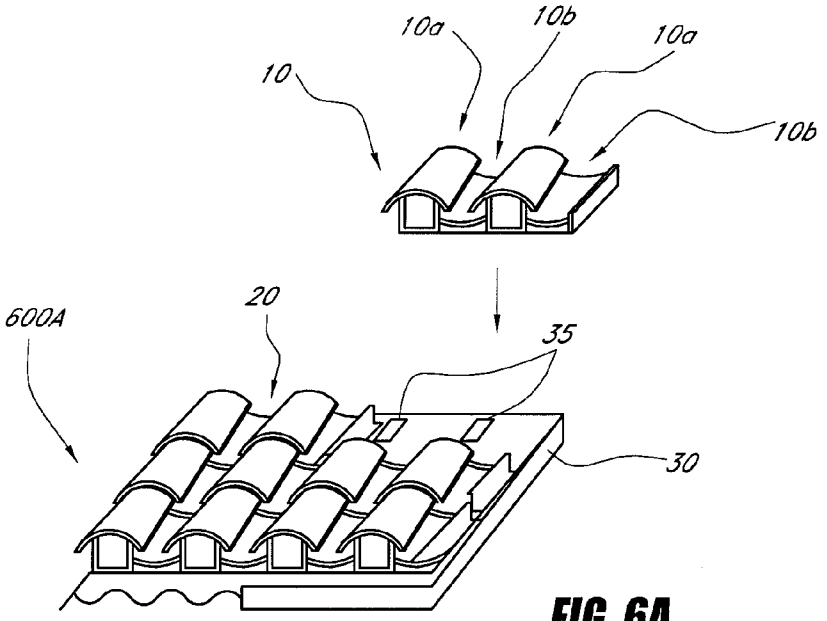


FIG. 6A

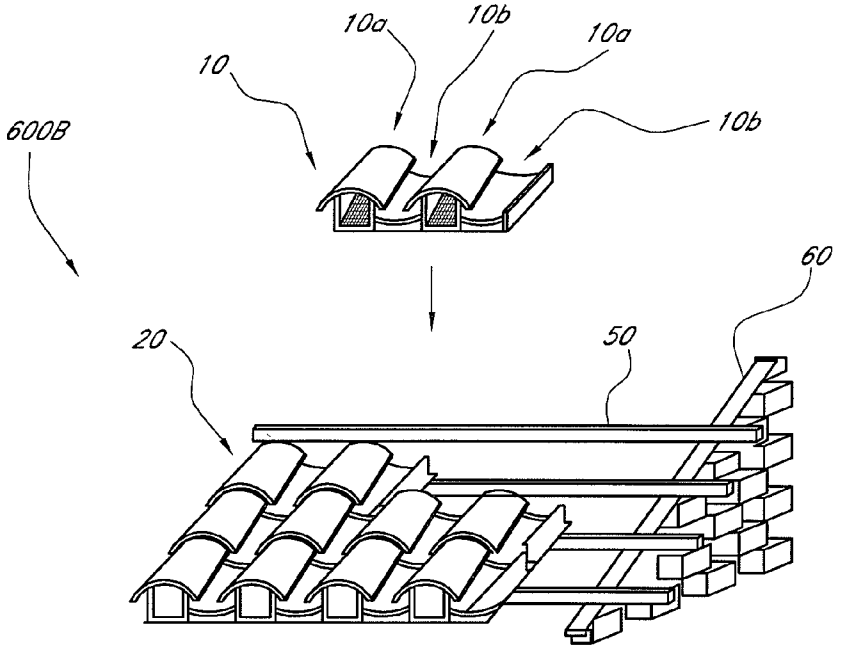


FIG. 6B

ROOF VENTILATION SYSTEM FOR TILED ROOF

CLAIM FOR PRIORITY

[0001] This application claims the priority benefit under 35 U.S.C. § 119(e) of Provisional Application Ser. No. 60/856,223, filed Nov. 1, 2006. The full disclosure of this priority application is incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] This application relates generally to building ventilation and specifically to roof ventilation.

[0004] 2. Description of the Related Art

[0005] Energy efficiency is a serious consideration in building design. Buildings require ways to minimize energy requirements to maintain comfortable living spaces. Certain buildings have a roof and an attic underneath the roof. One of the most common energy losses in such buildings is due to heat transfer through the attic. In warm climates, heat builds up in the attic from solar energy incident on the roof. In colder climates, moisture builds up in the attic, robbing the insulation of much of its R value.

[0006] Recently, ventilation systems have been incorporated to enhance the insulation of a roof. Such ventilation systems remove heat and/or moisture build-up in the attic, thus minimizing energy losses due to heat transfer through the attic.

[0007] Certain buildings include a roof with roof tiles having air channels. The air channels are formed through the roof tiles, and are in ventilating communication with one another. The air channels provide insulation between regions above and below the roof. Such buildings, however, may still have heat or moisture build-up in the attic. Therefore, there is still a need to provide a ventilation system that properly ventilates the attic. There is also a need to provide a ventilation system which minimally detrimentally affects the appearance of a roof design and is applicable to various types of roofs, while offering low installation costs relative to other ventilation systems.

SUMMARY OF THE INVENTION

[0008] Preferred embodiments of the present invention provide a roof structure for a tiled roof of a building. In accordance with a preferred embodiment, a roof structure is provided comprising a roof supporting structure and a plurality of roof tiles over the roof supporting structure. Each of the roof tiles comprises an upper plate, a lower plate, and an air channel formed through the roof tile between the upper and lower plates. The roof tiles are arranged in a plurality of groups. The roof tiles and air channels of each group of roof tiles are adjacently positioned so that the air channels of each group are in ventilating communication with one another and collectively form an air passage within the roof. At least one of the roof tiles comprises a vent tile comprising a first upper plate, a second upper plate underlying the first upper plate, and a lower plate including a second opening. The first and second upper plates have a gap therebetween. The second upper plate includes a first opening. The lower plate is positioned below the second upper plate with an air channel defined therebetween. The first opening is in ventilating communication with the second opening via the air channel of the vent tile. The gap and the first and second openings together permit airflow between regions above and below the roof.

[0009] In accordance with another preferred embodiment, a vent tile is provided comprising a first upper plate, a second upper plate underlying the first upper plate, a lower plate opposing the second upper plate, and sidewalls connecting the second upper plate to the lower plate. The first and second upper plates have a gap therebetween. The second upper plate includes a first opening. The lower plate includes a second opening. The second upper plate, the lower plate, and the sidewalls together define an air channel formed through the vent tile. The first and second openings are in ventilating communication with each other through the air channel.

[0010] In accordance with yet another preferred embodiment, a method of providing a roof structure for a tiled roof of a building is provided. The method comprises providing a roof supporting structure. Then, a plurality of roof tiles are provided over the roof supporting structure. In addition, each of the roof tiles comprises an upper plate, a lower plate, and an air channel formed through the roof tile between the upper and lower plates. The roof tiles are arranged in a plurality of groups. The roof tiles and air channels of each group of roof tiles are adjacently positioned so that the air channels of each group are in ventilating communication with one another and collectively form an air passage within the roof. Providing at least one of the roof tiles comprises providing a vent tile comprising a first upper plate, a second upper plate underlying the first upper plate, and a lower plate including a second opening. The first and second upper plates have a gap therebetween. The second upper plate includes a first opening. The lower plate is positioned below the second upper plate with an air channel defined therebetween. The first opening is in ventilating communication with the second opening via the air channel of the vent tile. The gap and the first and second openings together permit airflow between regions above and below the roof.

[0011] For purposes of summarizing the invention and the advantages achieved over the prior art, certain objects and advantages of the invention have been described above and as further described below. Of course, it is to be understood that not necessarily all such objects or advantages may be achieved in accordance with any particular embodiment of the invention. Thus, for example, those skilled in the art will recognize that the invention may be embodied or carried out in a manner that achieves or optimizes one advantage or group of advantages as taught herein without necessarily achieving other objects or advantages as may be taught or suggested herein.

[0012] All of these embodiments are intended to be within the scope of the invention herein disclosed. These and other embodiments of the present invention will become readily apparent to those skilled in the art from the following detailed description of the preferred embodiments having reference to the attached figure, the invention not being limited to any particular preferred embodiment(s) disclosed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. **1** is a perspective view of a building with a tiled roof having vent tiles in accordance with one embodiment of the present invention;

[0014] FIG. **2** is a perspective view of one embodiment of a roof structure having vent tiles;

[0015] FIG. **3**A is an exploded perspective view of one embodiment of a cap section of a vent tile;

[0016] FIG. **3**B is a top plan view of the cap section of the vent tile of FIG. **3**A;

[0017] FIG. **3**C is a top plan view of the second upper plate of the cap section of the vent tile of FIG. **3**A;

[0018] FIG. **3**D is a cross-sectional view of the cap section of the vent tile of FIG. **3**A, taken along the line **3**D-**3**D;

[0019] FIG. **3**E is a cross-sectional view of the cap section of the vent tile of FIG. **3**A, taken along the line **3**E-**3**E;

[0020] FIG. **4**A is a cross-sectional view of the roof structure of FIG. **2**, taken along the line **4**A-**4**A;

[0021] FIG. **4**B is a cross-sectional view of the roof structure of FIG. **2**, taken along the line **4**B-**4**B;

[0022] FIG. **5**A is a cross-sectional view of one embodiment of a roof tile.

[0023] FIGS. **5**B-**5**D are cross-sectional views of embodiments of vent tiles.

[0024] FIG. **6**A is a perspective view of another embodiment of a roof structure having a vent tile; and

[0025] FIG. **6**B is a perspective view of yet another embodiment of a roof structure having a vent tile.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0026] FIG. **1** shows a building **1** with a roof **2** according to one embodiment. The roof **2** comprises two fields **3***a* and **3***b* that are joined at their upper ends to define a ridge **4**. Lower edges **5** of the fields are referred to as "eaves." The fields **3***a* and **3***b* comprise a roof supporting structure (not shown) covered with tiles **20** (e.g., clay or concrete). The roof is suitable for having one or more vent tiles **10** according to one embodiment of the invention. Also, skilled artisans will appreciate that the vent tiles may be provided in a wide variety of different types of roofs, including those not having ridges or sloped fields. In FIG. **1**, a plurality of vent tiles **10** are lined up on the field **3** a along the ridge **4** and eave **5** of the roof **2**. The vent tiles **10** are preferably provided in each field **3***a*, **3***b*. In other embodiments, the vent tiles **10** may be positioned alternatively or additionally on different parts of the field **3***a*, **3***b*, depending on the ventilation needs.

[0027] FIG. **2** illustrates a portion of the roof **2** according to one embodiment. The illustrated portion of the roof **2** includes roof tiles **20** supported by a roof supporting structure **30**. Some of the roof tiles **20** comprise the aforementioned vent tiles **10**. As used herein, the reference numeral **20** refers to roof tiles that are not vent tiles **10**, unless otherwise indicated. However, it should be understood that each vent tile **10** is preferably a specialized roof tile **20**. The roof tiles **20** are arranged in columns and rows. The vent tiles **10** are positioned between two of the roof tiles **20** both in the horizontal direction and in the vertical direction. It will be appreciated that the positions of the vent tiles **10** may vary depending on the ventilation needs. The roof supporting structure **30** supports both the vent tiles **10** and the roof tiles **20**.

[0028] In FIG. **2**, each roof tile **20** includes a cap section **20***a* and a pan section **20***b*. When the tiles **20** are assembled, the tiles' cap sections **20***a* form cap columns, and the tiles' pan sections **20***b* form pan channels. Rainwater tends to flow downward within the pan channels. In an alternative embodiment, each roof tile **20** includes two or more cap sections **20***a* and two or more corresponding pan sections **20***b*. The vent tiles **10** preferably have the same number of cap sections **10***a* and pan sections **10***b* as the roof tiles **20**, preferably in the same size and shape so as to blend in visually and functionally with the roof tiles **20**.

[0029] Referring to FIG. **3**A, a cap section **10***a* of a vent tile **10** includes a first upper plate **11***a*, a second upper plate **11***b*, spacers **16**, a lower plate **12**, and sidewalls **13**. The first upper plate **11***a* covers the second upper plate **11***b* with a gap therebetween. The second upper plate **11***b* opposes the lower plate **12** with a space therebetween. The sidewalls **13** include a first sidewall **13***a* and a second sidewall **13***b* opposing each other. The second upper plate **11***b*, the lower plate **12**, and the two sidewalls **13***a*, **13***b*, together define a channel **17** formed through the cap section **10***a* of the vent tile **10**. While not shown in FIG. **3**A, a pan section can be attached or formed integrally with one of the sidewalls **13***a*, **13***b*. Also, the vent tile **10** can include any number of cap sections and pan sections, preferably matching the number, size, and shape of cap and pan sections of the roof tile **20**.

[0030] The first upper plate **11***a* forms a cover of the cap section **10***a* of the vent tile **10**. The illustrated first upper plate **11***a* is convex when viewed from above. In other embodiments, the first upper plate may have various other shapes and configurations. The first upper plate **11***a* may be formed of, without limitation, a metal, clay, a plastic material, or a combination of two or more of the foregoing.

[0031] In addition, the first upper plate **11***a* may have a downwardly depending baffle or flange **18** at its lower edge. The flange **18** may be configured to allow airflow underneath it while preventing ingress of rain or snow.

[0032] The second upper plate **11***b* forms an upper part of the cap section **10***a* of the vent tile **10**. The illustrated second upper plate **11***b* is shaped substantially similar or in conformity with the first upper plate **11***a*. In other embodiments, the second upper plate may have various other shapes and configurations. The second upper plate **11***b* may be formed of, without limitation, a metal, clay, a plastic material, or a combination of two or more of the foregoing.

[0033] The second upper plate **11***b* has a first opening **14***a* penetrating therethrough. The first opening **14***a* permits airflow between the channel **17** and a region above the vent tile **10**, as will be better understood from later description herein. In certain embodiments, the first opening **14***a* may include louvers. The louvers include a number of narrow slits formed in parallel to one another. It will be appreciated that the shape, number, and position of the slits can be varied, depending on the design of a vent tile. The first opening **14***a* may be covered by a screen **15***a* to prevent entry of insects, vermin, and debris larger than the screen openings (FIG. **3**C).

[0034] Referring to FIG. **3**E, the spacers **16** provide a gap between the first and second upper plates **11***a*, **11***b*, thereby forming a ventilating access therebetween. In the illustrated embodiment, the spacers **16** support the first upper plate **11***a* above the second upper plate **11***b*, forming a space throughout between the upper plates **11***a*, **11***b*. This configuration provides ventilating access in all directions from the cap section **10***a* of the vent tile **10**. In other embodiments, the ventilating access may be limited to a certain direction(s) from the cap section **10***a* of the vent tile **10**, e.g., down, left or right. A skilled artisan will appreciate that the configuration of the spacers **16** can be adapted to the design of the ventilating access. The spacers **16** may be attached to the first and second upper plates **11***a*, **11***b* in any suitable manner. In certain embodiments, the spacers **16** may be formed integrally with one or both of the upper plates **11***a*, **11***b*. The spacers **16** may be formed of, without limitation, a metal, a plastic material, or a combination of the foregoing.

[0035] The lower plate **12** forms a lower part of the cap section **10***a* of the vent tile **10**. The illustrated lower plate **12** is flat in shape. In other embodiments, the lower plate may have various other shapes. The lower plate **12** may be formed of, without limitation, a metal, clay, a plastic material, or a combination of two or more of the foregoing. Preferably, the lower plate **12** is formed of the same material as that of the upper plates **11***a*, **11***b*.

[0036] Referring to FIGS. **3**D and **3**E, the lower plate **12** has a second opening **14***b* penetrating therethrough. The second opening **14***b* permits airflow between the channel **17** and a region below the lower plate **12**. Referring to FIG. **3**D, the

illustrated second opening **14***b* is covered by a screen **15***b* to prevent entry of insects, vermin, and debris larger than the screen openings.

[0037] The sidewalls **13** connect the second upper plate **11***b* to the lower plate **12**. In the illustrated embodiment, the sidewalls **13** are integrally formed with the second upper plate **11***b* and the lower plate **12**. The sidewalls **13** may be secured to the second upper plate **11***b* and the lower plate **12**, using any suitable securing means. The sidewalls **13** may be formed of, without limitation, a metal, clay, a plastic material, or a combination of two or more of the foregoing. Preferably, the sidewalls **13** are formed of the same material as that of the second upper plate **11***b* and/or the lower plate **12**. Preferably, the sidewalls **13**, second upper plate **11***b*, lower plate **12**, and adjoining pan section(s) and additional cap section(s) (if any) are formed of the same material.

[0038] The channel **17**, as shown in FIG. **3**A, is in ventilating communication with the first and second openings **14***a*, **14***b*. In addition, the gap between the first and second upper plates **11***a*, **11***b* is in ventilating communication with the first opening **14***a*. This configuration permits airflow between regions above and below the roof **2**. The regions below the roof **2** may include an attic or a living space of a building. The channel **17** is also configured to be in ventilating communication with air channels of the roof tiles **20**, as will be better understood from later description herein.

[0039] Referring to FIG. **4**A, each of cap sections **20***a* of the roof tiles **20** includes an upper plate **21**, a lower plate **22**, and sidewalls **23**. The upper plate **21** opposes the lower plate **22** with a space therebetween. The sidewalls **23** include a first sidewall **23***a* and a second sidewall **23***b* opposing each other. The upper plate **21**, the lower plate **22**, and the two sidewalls **23***a*, **23***b*, together define an air channel **27** formed through the cap section **20***a* of the roof tile **20**.

[0040] The upper plate **21** forms an upper part of the cap section **20***a* of the roof tile **20**. The illustrated upper plate **21** is convex when viewed from above. In other embodiments, the upper plate may have various other shapes. Preferably, the upper plate **21** of the cap section **20***a* of the roof tile **20** has substantially the same shape as the first upper plate **11***a* of the cap section **10***a* of the vent tile **10**. The upper plate **21** may be formed of, without limitation, clay, a metal, a plastic material, or a combination of two or more of the foregoing. Preferably, the upper plate **21** is formed of clay.

[0041] The lower plate **22** forms a lower part of the cap section **20***a* of the roof tile **20**. The illustrated lower plate **22** is flat in shape. In other embodiments, the lower plate may have various other shapes. The lower plate **22** may be formed of, without limitation, clay, a metal, a plastic material, or a combination of two or more of the foregoing. Preferably, the lower plate **22** is formed of the same material as that of the upper plate **21**.

[0042] The sidewalls **23** connect the upper plate **21** to the lower plate **22**. In the illustrated embodiment, the sidewalls **23** are integrally formed with the upper and lower plates **21**, **22**. In other embodiments, the sidewalls **23** may be secured to the upper and lower plates **21**, **22**, using any suitable securing means. The sidewalls **23** may be formed of, without limitation, clay, a metal, a plastic material, or a combination of two or more of the foregoing. Preferably, the sidewalls **23** are formed of the same material as that of the upper plate **21** or the lower plate **22**. Preferably, the upper plate **21**, lower plate **22**, and sidewalls **23** are formed of the same material.

[0043] FIG. **4**A illustrates a cross-section of the roof **2** of FIG. **2**, taken along the line **4**A-**4**A. The roof tiles **20** are arranged parallel to one another on the roof supporting structure **30**. The vent tiles **10** are interposed between two of the roof tiles **20** in the illustrated cross-section. Referring to the embodiment of FIG. **4**A, the first and second openings **14***a*, **14***b* of the vent tiles **10** are in ventilating communication with apertures **35** of the roof supporting structure **30**. In addition, the ventilating access between the first and second upper plates **11***a*, **11***b* is in ventilating communication with the first opening **14***a* of the second upper plate **11***b*. This configuration permits airflow between regions above and below the roof **2**, and thus reduces heat or moisture build-up in the regions below the roof **2**. The regions below the roof **2** may include an attic or a living space of a building.

[0044] FIG. **4**B is a cross-section of the roof **2** of FIG. **2**, taken along the line **4**B-**4**B. In this embodiment, the roof tiles **20** are arranged in lines (or "columns" or "groups") extending between the eave and ridge (not shown) of the roof **2**. The roof tiles **20** are arranged such that the air channels **27** of the roof tiles **20** of each aligned group of roof tiles are in ventilating communication with one another to collectively form air passages extending within the roof. As described above, the air channels **27** are optionally located within the cap sections **20***a* of the roof tiles **20**. This configuration provides insulation throughout the roof **2**. Preferably, one or more of the roof tiles **20** in each aligned group of roof tiles **20** is replaced by a vent tile **10**. Thus, the air channels **27** of the roof tiles **20** are also in ventilating communication with the first opening **14***a* and second opening **14***b* of the vent tile **10**. This configuration permits ventilation of the air channels **27** of the roof tiles **20**. The ventilation of the air channels **27** facilitates ventilation of the building while preserving the insulative effect of the air passages, each of which is defined by a group of air channels **27** (of roof tiles **20**) and one or more air channels **17** (of vent tiles **10**).

[0045] In FIG. **4**B, the vent tile **10** is positioned vertically between two of the roof tiles **20**. In another embodiment, the vent tile **10** may be located near the eave or ridge of the roof, as shown in FIG. **1**, and may have only one neighboring roof tile **20**. In certain embodiments, two or more vent tiles **10** may be provided in an aligned group or column of roof tiles **20**. The vent tiles **10** may be provided in every aligned group or column of roof tiles **20** throughout the roof. In another embodiment, the vent tiles **10** may be provided in every other aligned group or column of roof tiles **20**. A skilled artisan will appreciate that the number and positions of the vent tiles **10** may vary depending on the ventilation needs.

[0046] Referring back to FIG. **4**A, cap sections **10***a* of the vent tiles **10** and cap sections **20***b* of the roof tiles **20** can be positioned between pan sections **10***b*, **20***b*. More specifically, each pan section **10***b* can be positioned between two cap sections **10***a* or between a cap section **10***a* and a cap section **20***a*, and each pan section **20***b* can be positioned between two cap sections **20***a* or between a cap section **20***a* and a cap section **10***a*. The illustrated pan section **10***b*, **20***b* includes an upper plate **41**, a lower plate **42**, and a central wall **48**, but other configurations are possible. The illustrated upper plate **41** is concave when viewed from above. The lower plate **42** is flat in shape. The central wall **48** connects the upper plate **41** with the lower plate **42**. The upper plate **41**, the lower plate **42**, and the central wall **48** together define air channels **47**. These air channels **47** can be in ventilating communication with the air channels **47** of a neighboring roof tile (not shown). This configuration provides further insulation of the roof.

[0047] FIG. **5**A illustrates one embodiment of a roof tile **520** having two cap sections **501** and two pan sections **502**. The cap sections **501** and the pan sections **502** may be all integrated with one another, forming a single piece, and are preferably formed integrally. They may be fixed to one another using any suitable fastening means. Examples of the

fastening means include, but are not limited to, bolts, nuts, nails, screws, adhesives, and solder. This combined structure permits ease of handling and installing. In other embodiments, however, the cap sections **501** and the pan sections **502** may be provided separately. A skilled artisan will appreciate that various configurations of tile structures are possible.

[0048] FIGS. **5**B-**5**C illustrate various embodiments of vent tiles **510**B, **510**C, **510**D configured to blend in visually and functionally with the roof tile **520** of FIG. **5**A. Each of the vent tiles **510**B, **510**C, **510**D has two cap sections **501**, **503** and two pan sections **502**. The cap sections **501**, **503** and the pan sections **502** may be all integrated with one another, forming a single piece, and are preferably formed integrally.

[0049] The vent tile **510**B of FIG. **5**B includes two ventilating cap sections **503** and two pan sections **502**. The vent tile **510**C of FIG. **5**C includes one non-ventilating cap section **501**, one ventilating cap section **503**, and two pan sections **502**. The vent tile **510**D of FIG. **5**D also includes one non-ventilating cap section **501**, one ventilating cap section **503**, and two pan sections **502**. The ventilating cap section **503** and the non-ventilating cap section **501** of the vent tile **510**D, however, have an opposite arrangement from those of the vent tile **510**C. It will be appreciated that various other configurations of vent tiles are possible.

[0050] The vent tile **10**, as shown in FIGS. **2**-**5**, may have the same shape as that of the roof tiles **20**. The vent tile **10** preferably mimics the appearance of the roof tiles **20**. This configuration avoids detrimentally affecting the appearance of the roof. In another embodiment, however, the vent tile may have a different shape and size to meet ventilation and/or decorative needs.

[0051] The roof supporting structure supports both the vent tiles **10** and the roof tiles **20**. Referring to FIG. **6**A, a roof **600**A includes a roof supporting structure comprising a roof deck **30**. The illustrated roof deck **30** directly supports the vent tiles **10** and the roof tiles **20**. In this embodiment, the roof deck **30** includes apertures **35** over which the vent tiles **10** are placed. The apertures **35** are in ventilating communication with the second openings **14***b* of the vent tile lower plates **12**, as shown in FIG. **4**A. This configuration permits airflow between regions above and below the roof **600**A.

[0052] In another embodiment, the roof supporting structure may further include battens interposed between the roof deck **30** and the tiles **10**, **20**. The battens may run parallel to one another and to the eave and ridge of the roof. The battens may directly support the tiles **10**, **20**. The battens are preferably configured to not interrupt the air passages collectively formed by the air channels **27** of the roof tiles **20**.

[0053] In certain embodiments, the roof supporting structure may also include a radiant barrier layer. The radiant barrier layer may reside over and substantially across the roof supporting structure. The radiant barrier layer includes a radiant barrier material that reflects radiant heat away from the roof. The radiant barrier material may comprise a sheet or coating. The coating may be formed of a paint blended with a radiant barrier additive. The radiant barrier material may preferably include a highly reflective material, such as aluminum. The radiant barrier layer may further include a substrate material such as kraft paper, plastic films (e.g., polypropylene and polyethylene), or cardboard. Another type of radiant barrier layer comprises bubble wrap with one or both sides covered with aluminum foil. In certain embodiments, the radiant barrier layer is reinforced by fiber to increase the durability and ease of handling. The radiant barrier may also include apertures in ventilating communication with the apertures of the roof deck **30** and the second openings **14***b* of the vent tile lower plates **12**.

[0054] Referring to FIG. **6**B, the roof supporting structure may include rafters **60** and battens **50** without a roof deck. The battens **50** directly support the tiles **10**, **20**. In this embodiment, no aperture is required in the roof supporting structure because the spaces between the battens are open for airflow. In certain embodiments, the roof supporting structure may also include a radiant barrier layer attached to either or both of the rafters and battens. The configuration of the radiant barrier layer may be as described above with reference to FIG. **6**A.

[0055] The roof tiles described above (e.g., **10**, **20**) may be installed in a roof as follows. In one embodiment where the roof supporting structure has only rafters and battens without a roof deck or a radiant barrier, the vent tiles **10** are simply installed sequentially with the roof tiles **20**.

[0056] In another embodiment where the roof supporting structure comprises a roof deck and/or a radiant barrier layer, apertures (e.g., **35**) are formed through the deck and/or the radiant barrier layer. Then, the roof tiles **20** and vent tiles **10** are mounted thereon. The vent tiles **10** are installed at the apertures such that the second openings **14***b* of the vent tile lower plates **12** are aligned with the apertures. A skilled artisan will appreciate that various other steps or processes may be used for installing the roof tiles **20** and the vent tiles **10**.

[0057] According to the embodiments described above, the roof structure includes vent tiles mimicking the appearance of roof tiles. This configuration enhances the insulating of the roof without detrimentally affecting the appearance of the roof. It will be understood that the appearance of the vent tiles and roof tiles can be different than that of the tiles **10**, **20** disclosed herein.

[0058] Although this invention has been disclosed in the context of certain preferred embodiments and examples, it will be understood by those skilled in the art that the present invention extends beyond the specifically disclosed embodiments to other alternative embodiments and/or uses of the invention and obvious modifications thereof. Thus, it is intended that the scope of the present invention herein disclosed should not be limited by the particular disclosed embodiments described above, but should be determined only by a fair reading of the claims that follow.

What is claimed is:

1. A roof structure for a tiled roof of a building, the structure comprising:

a roof supporting structure; and

a plurality of roof tiles over the roof supporting structure, each of the roof tiles comprising an upper plate, a lower plate, and an air channel formed through the roof tile between the upper and lower plates, the roof tiles being arranged in a plurality of groups, wherein the roof tiles and air channels of each group of roof tiles are adjacently positioned so that the air channels of each group are in ventilating communication with one another and collectively form an air passage within the roof;

wherein at least one of the roof tiles comprises a vent tile comprising:

a first upper plate;

a second upper plate underlying the first upper plate, the first and second upper plates having a gap therebetween, the second upper plate including a first opening; and

a lower plate including a second opening, the lower plate positioned below the second upper plate with an air channel defined therebetween, the first opening being in ventilating communication with the second open-

ing via the air channel of the vent tile, wherein the gap and the first and second openings together permit airflow between regions above and below the roof.

2. The structure of claim **1**, wherein the roof tiles and air channels of a first of the groups of roof tiles are substantially aligned, and wherein one of the roof tiles of the first group of roof tiles comprises the vent tile.

3. The structure of claim **2**, wherein the roof tiles of the first group are substantially aligned in a direction extending substantially parallel to a ridge of the roof.

4. The structure of claim **2**, wherein the roof tiles of the first group are substantially aligned in a direction extending substantially perpendicular to a ridge of the roof.

5. The structure of claim **2**, wherein the vent tile is interposed between two of the roof tiles of the first group of roof tiles.

6. The structure of claim **2**, wherein the vent tile is positioned at an end of the first group of roof tiles.

7. The structure of claim **2**, wherein the air passage of the first group of roof tiles substantially extends from a ridge to an eave of the roof.

8. The structure of claim **7**, wherein the vent tile of the first group is located near one of the ridge and the eave of the roof.

9. The structure of claim **7**, wherein an end of the air passage of the first group is open at the eave of the roof to an exterior of the building.

10. The structure of claim **1**, wherein the roof tiles cover substantially the entire roof supporting structure, and wherein the air passages of the groups of roof tiles are formed throughout the roof.

11. The structure of claim **1**, wherein the roof supporting structure comprises battens supporting the roof tiles.

12. The structure of claim **1**, wherein the roof supporting structure comprises a roof deck supporting the roof tiles, and wherein the roof deck has an aperture in ventilating communication with the second opening of the vent tile.

13. The structure of claim **1**, wherein the first opening comprises louvers in the second upper plate.

14. The structure of claim **1**, wherein the vent tile further comprises a screen covering at least one of the first and second openings.

15. The structure of claim **1**, wherein the vent tile comprises a metal.

16. The structure of claim **1**, wherein the vent tile comprises a material the same as that of the roof tiles that are not vent tiles.

17. The structure of claim **1**, wherein the vent tile has substantially the same shape as that of the roof tiles that are not vent tiles.

18. The structure of claim **1**, wherein the vent tile mimics an appearance of the roof tiles that are not vent tiles.

19. The structure of claim **1**, wherein the plurality of roof tiles comprise at least one roof tile comprising at least one cap section and at least one pan section, and wherein the vent tile includes the same number of cap sections and pan sections as the at least one roof tile.

20. The structure of claim **19**, wherein the first upper plate, the second upper plate, and the lower plate of the vent tile together resemble one of the at least one cap section of the at least one roof tile.

21. A vent tile comprising:

a first upper plate;

a second upper plate underlying the first upper plate, the first and second upper plates having a gap therebetween, the second upper plate including a first opening;

a lower plate opposing the second upper plate, the lower plate including a second opening; and

sidewalls connecting the second upper plate to the lower plate,

wherein the second upper plate, the lower plate, and the sidewalls together define an air channel formed through the vent tile, and

wherein the first and second openings are in ventilating communication with each other through the air channel.

22. The vent tile of claim **21**, further comprising at least one spacer interposed between the first and second upper plates.

23. A method of providing a roof structure for a tiled roof of a building, the method comprising:

providing a roof supporting structure;

providing a plurality of roof tiles over the roof supporting structure, each of the roof tiles comprising an upper plate, a lower plate, and an air channel formed through the roof tile between the upper and lower plates;

arranging the roof tiles in a plurality of groups; and

adjacently positioning the roof tiles and air channels of each group so that the air channels of each group are in ventilating communication with one another and collectively form an air passage within the roof,

wherein providing the plurality of the roof tiles comprises providing a vent tile comprising:

a first upper plate;

a second upper plate underlying the first upper plate, the first and second upper plates having a gap therebetween, the second upper plate including a first opening; and

a lower plate including a second opening, the lower plate positioned below the second upper plate with an air channel defined therebetween, the first opening being in ventilating communication with the second opening via the air channel of the vent tile, wherein the gap and the first and second openings together permit airflow between regions above and below the roof.

24. The method of claim **23**, wherein adjacently positioning the roof tiles and air channels of each group comprises substantially aligning the roof tiles of a first group of roof tiles, and wherein one of the roof tiles of the first group of roof tiles comprises the vent tile.

25. The method of claim **23**, wherein the vent tile has substantially the same shape as that of the roof tiles that are not vent tiles.

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